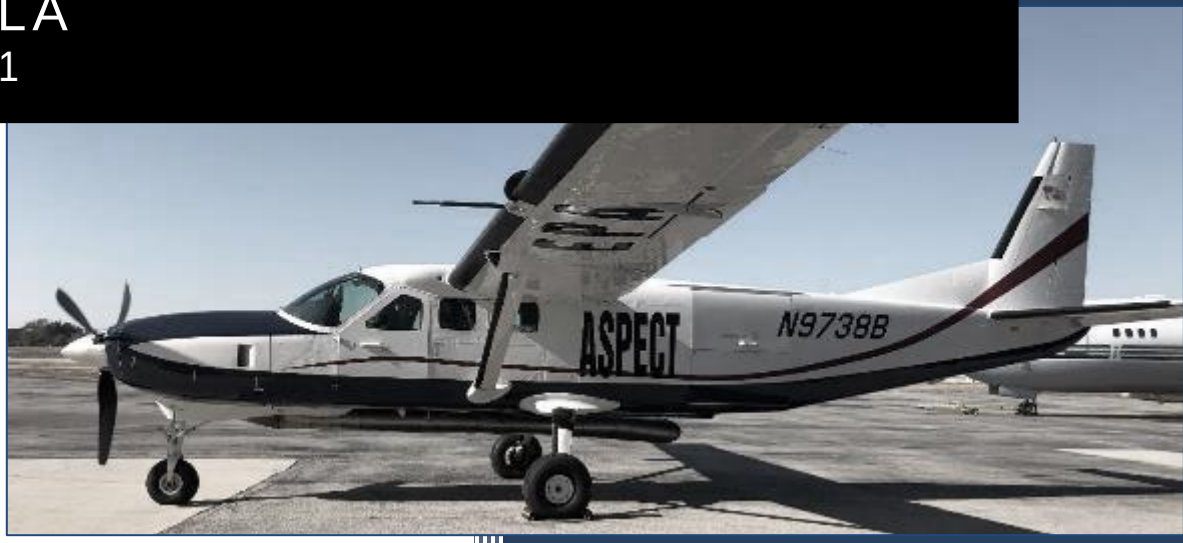
Airborne
Spectral
Photometric
Environmental
Collection
Technology

# ASPECT Air Quality Survey for Hurricane Ida
# Baton Rouge, LA
September 8, 2021

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## Acronyms and Abbreviations

| | |
|---|---|
| Alt | Altitude (in feet) |
| AGL | Above Ground Level |
| cm | centimeter |
| CDT | Central Daylight Time |
| DEM | Digital Elevation Model |
| ESF-10 | Emergency Support Function #10 – Oil and Hazardous Materials Response |
| FEMA | Federal Emergency Management Agency |
| FTIR | Fourier Transform Infrared Spectrometer |
| FTP | File Transfer Protocol |
| igm | Spectral data format based on grams format |
| IR | Infrared |
| IRLS | Infrared Line Scanner |
| jpg | JPEG image format |
| kts | knots |
| mph | miles per hour |
| m/s | meters per second |
| MSIC | Digital photography file from the Imperx mapping camera |
| MSL | Mean Sea Level Altitude (in feet) |
| PAN | peroxyacetyl nitrate |
| Ppm | parts per million |
| RMP | Risk Management Plan |
| UTC | Universal Time Coordinated |

**Executive Summary**

Hurricane Ida made landfall at 11:55 AM CDT Sunday, August 29 as a high-end category-4 hurricane, with maximum sustained winds of 150 mph. The storm moved ashore near Port Fourchon, Louisiana after a period of rapid intensification, tying for the fifth strongest landfalling continental US hurricane on record with Hurricane Laura of 2020, among three other hurricanes. Severe wind and large-scale flood damage have been reported to property and infrastructure in much of southeast Louisiana, including significant damage in New Orleans, Louisiana. In addition, Ida has caused widespread damage across the Mid-Atlantic and Northeast US.

On September 2nd, 2021, the State of Louisiana requested ESF-10 assistance through FEMA and Region 6 asked for the ASPECT plane to be deployed in support of the response to Hurricane Ida. The state wanted assistance monitoring facility emissions in the industrial area between Baton Rouge and New Orleans, where flaring is resulting in the visible emission of black smoke.

ASPECT was tasked to perform remote chemical sensing over target properties to screen for airborne chemicals and take high-resolution photos to provide situational awareness. Potential areas identified for monitoring included: East Baton Rouge, Ascension, Iberville, St. James, St. John, St. Charles, Jefferson, and Orleans. The system conducted one flight mission on 2 September 2021 including air monitoring survey collections over the target area with favorable weather conditions for all passes. Although two black plumes were visible over one of the sites, no major emissions were detected with the FTIR.

A continuation of the overall Baton Rouge facility survey was conducted on September 3. Two data collection flights were conducted which bracketed a Presidential temporary flight restriction not allowing any flight activity. A total of 12 active data collection passes were made covering 8 facilities with no chemical plumes or compounds being detected. Other than flares and isolated steam plumes, little process activity was noted in the data.

Flight 5 and 6 were conducted as part of survey operations conducted on September 4. A total of 17 facilities were surveyed. Ammonia was detected and confirmed at a maximum concentration of approximately 14 ppm in addition to ozone and peroxyacetyl nitrate. Analysis of IR imagery indicated that some facilities are showing hot process units.

ASPECT conducted two data collection missions on September 5 with the focus being facilities in St. Bernard, Terrebonne, St. Charles, and St. James areas. A total of 32 active data collection passes were made covering 21 facilities. Imagery collected within impact areas of the storm showed some oil sheen and releases to secondary containment. No compounds were detected on either mission.

Two data collection missions were conducted by ASPECT on September 7 with the primary focus to collect additional data over targets surveyed on September 5 (St. Bernard, Terrebonne, St. Charles, and St. James areas). A total of 16 data collection

passes (2 test and 14 active) were made over about half of the target list. Weather conditions complicated the mission with numerous convective cells and low clouds in the area. No compounds were detected on either flight.

ASPECT conducted two missions on September 8 with the primary objective to complete the mission of collecting additional data at facilities assigned on September 7. Weather conditions over the target areas within St. Bernard, Terrebonne, St. Charles, and St. James parishes was marginal due to clouds and convective activity. A total of 21 data collection passes (2 test and 19 active) were required to complete the mission with no detections observed.

# ASPECT Air Quality Survey
# Hurricane IDA
# Baton Rouge, LA
# September 8, 2021

**Background and Operational Overview**

Hurricane Ida made landfall at 11:55 AM CDT Sunday, August 29 as a high-end category-4 hurricane, with maximum sustained winds of 150 mph. The storm moved ashore near Port Fourchon, Louisiana after a period of rapid intensification, tying for the fifth strongest landfalling continental US hurricane on record with Hurricane Laura of 2020, among three other hurricanes. Severe wind and large-scale flood damage have been reported to property and infrastructure in much of southeast Louisiana, including significant damage in New Orleans, Louisiana. In addition, Ida has caused widespread damage across the Mid-Atlantic and Northeast US.

On September 2, ASPECT was tasked to conduct a wide area air quality screening level assessment of areas populated with Risk Management Plan (RMP) sites and petrochemical facilities using the ASPECT system for detections of any airborne contaminants from ASPECT's 76 chemical detection library in the areas affected by Ida. The Region wanted to know if any detections were found, the location of the detection, and the concentration detected. Sites including Marathon Petroleum Company, Shell Norco Facility, and Phillips 66 pipeline site were surveyed. There were no chemical detections at the sites surveyed. Extremely slow satellite transmission speeds (possibly due to high bandwidth use by other first responders) resulted in long delays in data collection. Some chemical photos were pulled down during flight, with the majority needing to be pulled down with a more high-speed internet connection on the ground.

On September 3 ASPECT was tasked with a continuation of the general Baton Rouge area survey and conducted two flights. 8 locations in the Baton Rouge area were surveyed as part of two flights. A total of 12 active data collection passes were made covering 8 facilities with no chemical plumes or compounds being detected. Other than flares and isolated steam plumes, little process activity was noted in the data.

Two data collection flights were conducted on September 4 focusing on facilities south of Baton Rouge. A total of 29 active data collection passes were made covering 17 facilities. Analysis of IR imagery indicated that some facilities are showing hot process units. Ammonia was detected and confirmed at a maximum concentration of approximately 14 ppm.

ASPECT conducted two data collection missions on September 5 with the focus being facilities in St. Bernard, Terrebonne, St. Charles, and St. James areas. A total of 32 active data collection passes were made covering 21 facilities. Imagery collected within impact

areas of the storm showed some oil sheen and releases to secondary containment. No compounds were detected on either mission.

Due to poor weather, ASPECT did not conduct any flight activities on September 6. ASPECT was tasked with two missions on 7 September consisting largely of revisiting facilities surveyed on September 5 for the purpose of collecting additional data.

ASPECT was tasked with two missions on September 8 for the purpose of collecting additional data for those facilities and sites surveyed on September 5. This report details the significant findings of these two survey missions.

**Table 1. Sites Covered on September 8, 2021**

| | | | |
|---|---|---|---|
| Valero Refining - Meraux LLC - Meraux Refinery | 29.930222 | -89.944917 | St. Bernard |
| Cornerstone Chemical Company | 29.964722 | -90.264722 | Jefferson |
| Chalmette Refining LLC | 29.937903 | -89.969903 | St. Bernard |
| BASF Corp - Geismar Site | 30.18425 | -91.002778 | Ascension |
| Equilon Enterprises LLC dba Shell Oil Products US - Convent Refinery | 30.107684 | -90.890796 | St. James |
| Occidental Chemical Corporation - Geismar Facility | 30.18819 | -90.98188 | Ascension |
| St Rose Refinery LLC - St Rose Refinery | 29.950875 | -90.328497 | St. Charles |
| Shell Chemical LP - Norco Chemical Plant West Site | 30.004925 | -90.422381 | St. Charles |
| Roehm America LLC - MMA Plant | 29.9575 | -90.265833 | Jefferson |
| Valero Refining - New Orleans LLC - St Charles Refinery | 29.985781 | -90.3955 | St. Charles |
| Shell Chemical LP - Norco Chemical Plant - East Site | 29.995556 | -90.409722 | St. Charles |
| Stolthaven New Orleans, LLC - Braithwaite Facility | 29.870919 | -89.949339 | Plaquemines |
| Formosa Plastics Corp Louisiana | 30.501722 | -91.185944 | East Baton Rouge |
| Occidental Chemical Corp - Taft Plant | 29.987222 | -90.454722 | St. Charles |
| Mosaic Fertilizer LLC - Faustina Plant | 30.083914 | -90.91345 | St. James |
| NuStar Logistics LP - St James Terminal | 30.030065 | -90.843463 | St. James |
| Dyno Nobel LA Ammonia LLC - Ammonia Production Facility | 29.964789 | -90.264625 | Jefferson |
| Kemira Chemicals Inc | 29.964722 | -90.264722 | Jefferson |
| PHILLIPS 66 PIPELINE LLC | 29.923889 | -90.482498 | St. Charles |

## General Mission Objectives

Once granted access to fly over the sites, the following general mission objectives were employed in conducting data collection with ASPECT:

1. To capture an overall, situational awareness of the incident using aerial photography with:
    - Oblique camera—photos taken by hand from the view/position of the co-pilot, and
    - MSIC photos—advanced camera mounted underneath the plane for a top-down view of the designated sites.

2. To qualitatively locate and characterize any the visible and non-visible components of a plume, as well as any areas on fire:
    - Using the Infrared Line Scanner (IRLS)
3. To screen for the presence and location of specific chemicals within ASPECT's automated chemical detection library:
    - Using the Fourier Transform Infrared (FTIR) Spectrometer

**Flight Conditions and Status**

Weather and Site Conditions

Prior to each flight, an updated status of the current and forecasted weather, site conditions and any potential flight obstacles including radio towers impacting safety is assessed by the crew. A summary of the ground weather conditions during the missions can be found in Tables 2 and 3.

**Table 2. Ground Weather for Baton Rouge, LA, Flight 11 September 8, 2021**

| Time | 753 | 853 | 953 | 1053 |
|---|---|---|---|---|
| Wind direction | 0 degrees N | 0 degrees N | 22.5 degrees NNE | 0 degrees N |
| Wind speed | 0.4 m/s (1.0 mph) | 0.4 m/s (1.0 mph) | 2.2 m/s (5.0 mph) | 0.4 m/s (1.0 mph) |
| Temperature | 22.8 C | 23.9 C | 26.1 C | 27.8 C |
| Relative humidity | 100 | 96 | 88 | 77 |
| Dew point | 22.8 C | 23.3 C | 23.9 C | 23.3 C |
| Pressure | 1011.2 mb | 1011.6 mb | 1012.6 mb | 1012.3 mb |
| Ceiling | Clear | Clear | Clear | Few 1700 Ft |

**Table 3. Ground Weather for Baton Rouge, LA, Flight 12 September 8, 2021**

| Time | 1253 | 1353 | 1453 | 1553 | 1653 |
|---|---|---|---|---|---|
| Wind direction | 0 degrees | 0 degrees | 292.5 degrees WNW | 0 degrees | 0 degrees N |
| Wind speed | 1.3 m/s (3.0 mph) | 1.3 m/s (3.0 mph) | 2.7 m/s (6.0 mph) | 2.7 m/s (6.0 mph) | 3.1 m/s (7.0 mph) |
| Temperature | 30.6 C | 31.1 C | 30.6 C | 30.6 C | 30.0 C |
| Relative humidity | 63 | 66 | 65 | 65 | 67 |
| Dew point | 22.8 C | 23.9 C | 23.3 C | 23.3 C | 23.3 C |
| Pressure | 1011.2 mb | 1010.9 mb | 1009.9 mb | 1009.5 mb | 1009.5 mb |
| Ceiling | Few 2800 Ft | Scattered 4100 Ft | Broken 3500 Ft | Scattered 3600 Ft | Scattered 3100 Ft |

## Data Results

The following data is provided as a summary analysis. All data products are available for the Region to access on a shared FTP site. For a complete list of available products, see Appendix A. The data collected during these missions included a flight path summary, IRLS images, FTIR chemical identification and quantification, high resolution MSIC photos, and oblique photos.

Flight Paths

Wide, slow turns are required to be made in between runs to keep the instruments stable. The blue lines indicate the flight path while the green lines indicate the specific sections of the flight where chemical data was collected and processed. On Flight 11 and 12, the St. Bernard, Terrebonne, St. Charles, and St. James areas were surveyed, and the flight paths are shown in Figures 1 and 2.

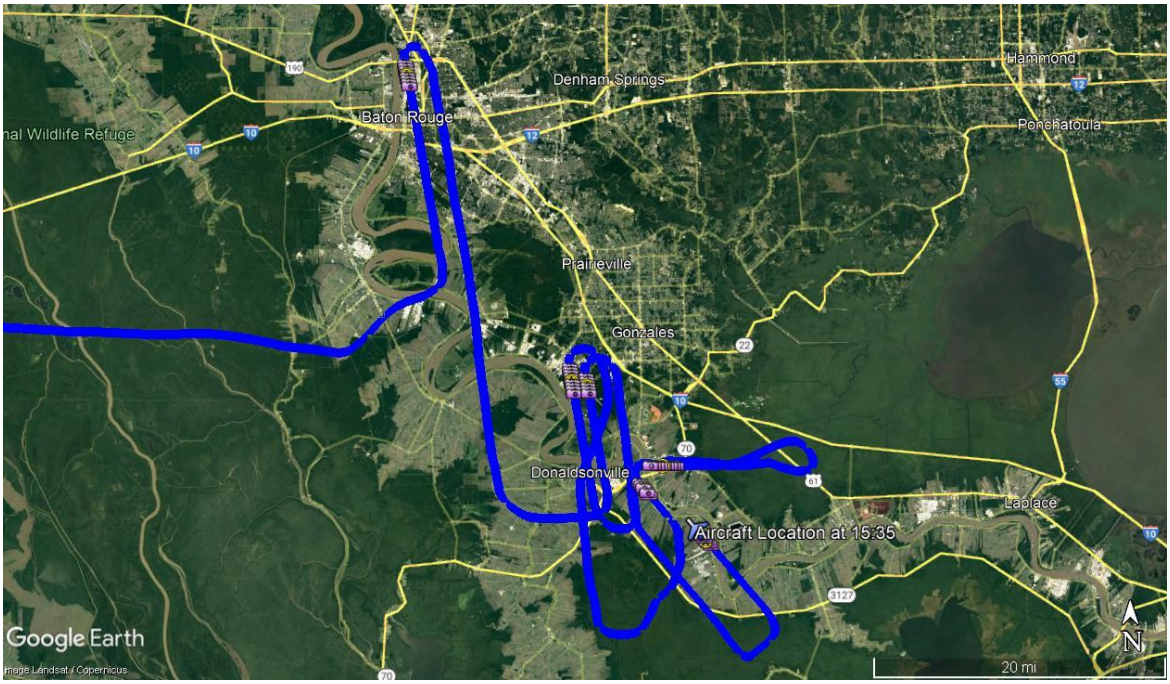


Figure 1. Data Collection Flight Path,
St. Bernard, Terrebonne, St. Charles, and St. James, Flight 11,
September 8, 2021

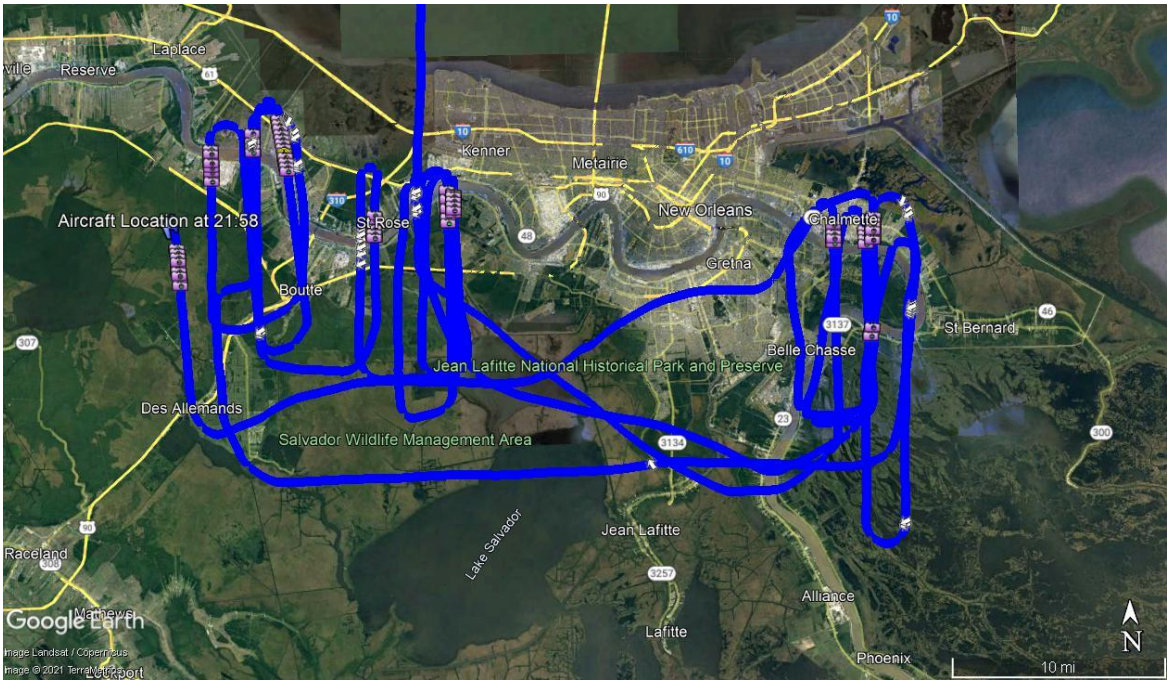


Figure 2. Data Collection Flight Path,
St. Bernard, Terrebonne, St. Charles, and St. James, Flight 12,
September 8, 2021

Line Scanner Data Results

A total of 21 data collection runs (2 tests and 19 active) were made over the target facilities and an infrared line scanner image was generated for each collection run. Figure 3 shows a 3-band infrared image collected over the Shell Convent refinery. Analysis of the image shows elevated piping and hot units in the main process section of the facility. No discharges can be seen leaving the facility. Figure 4 shows a similar image collected over the Valero Refining Meraux Refinery. Hot flares in the lower portion of the image in addition to some hot process piping is evident.

Figure 3. Three band IR image, Equilon Enterprises LLC dba Shell Oil Products US - Convent Refinery, Flight 11, September 8, 2021

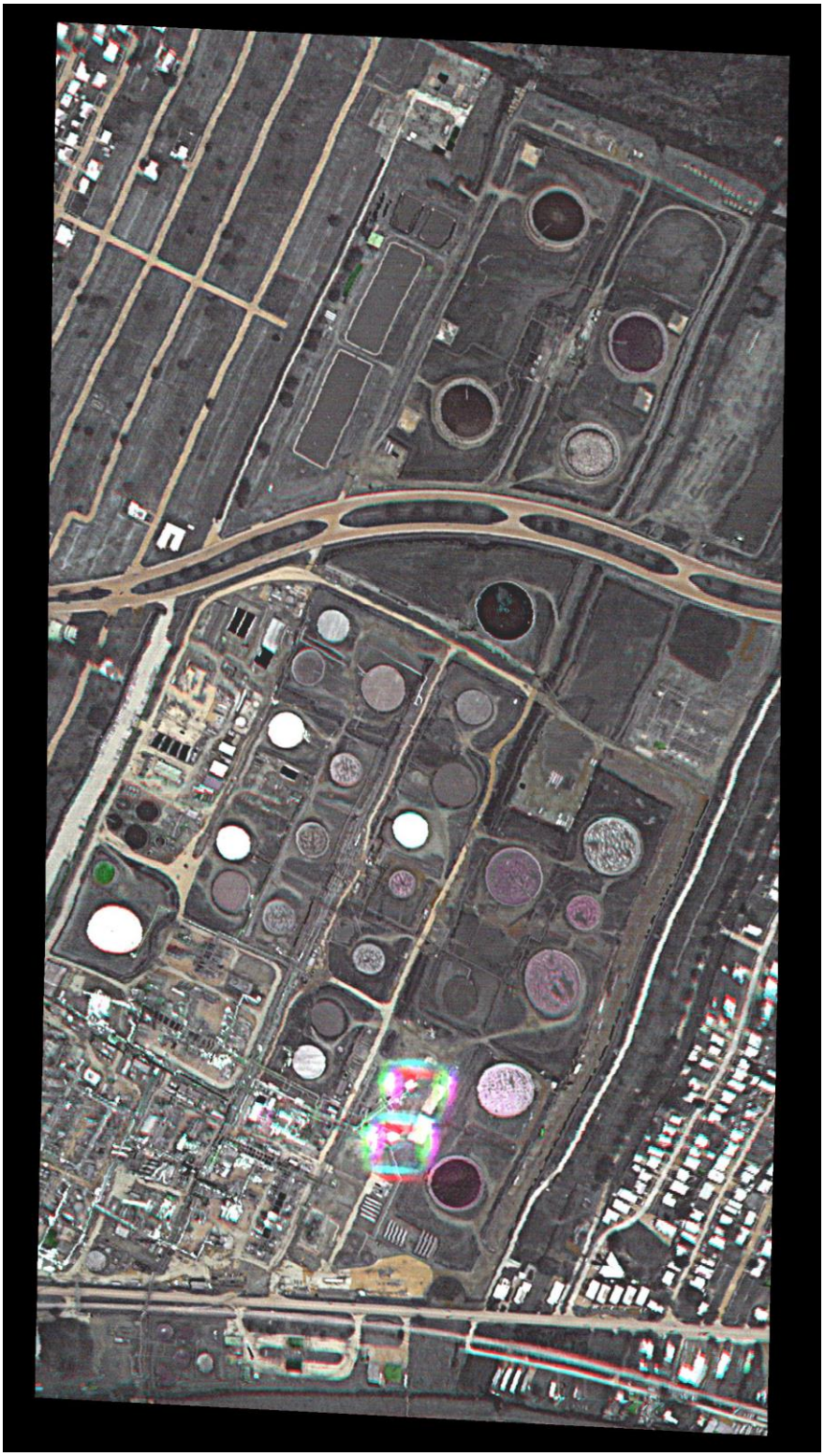

Figure 4. Three band IR image, Valero Refining - Meraux LLC - Meraux Refinery, Flight 12, September 8, 2021

FTIR Data Results

FTIR spectral data at a resolution of 16 wavenumbers was collected for each run. ASPECT uses an automated detection algorithm to permit compounds to be automatically analyzed while the aircraft is in flight. Seventy-six chemical compounds are included in the airborne algorithm library (the list is provided in Appendix B, Table 1). In addition, collected data was also manually quality checked against a collection of published library spectra for each chemical detected.

ASTECT did not detect any programmed compounds (those found in Appendix B, Table 1) as part of the mission over the target areas on the two flights conducted on September 8. Details of the monitoring results can be found in Tables 4 and 5.

**Table 4. Chemical Results Summary**
**St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 11**

| Pass | Date | Time (UTC) | Chemical | Max Concentration (ppm) |
|---|---|---|---|---|
| 1 | 2021-09-08 | 13:33:30 | Test | Test |
| 2 | | 14:17:52 | ND | ND |
| 3 | | 14:40:19 | ND | ND |
| 4 | | 14:52:31 | ND | ND |
| 5 | | 15:09:37 | ND | ND |
| 6 | | 15:21:28 | ND | ND |
| 7 | | 15:34:50 | ND | ND |

**Table 5. Chemical Results Summary**
**St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 12**

| Pass | Date | Time (UTC) | Chemical | Max Concentration (ppm) |
|---|---|---|---|---|
| 1 | 2021-09-08 | 18:34:18 | Test | Test |
| 2 | | 19:01:56 | ND | ND |
| 3 | | 19:15:34 | ND | ND |
| 4 | | 19:44:16 | ND | ND |
| 5 | | 19:55:29 | ND | ND |
| 6 | | 20:07:03 | ND | ND |
| 7 | | 20:19:49 | ND | ND |
| 8 | | 20:32:08 | ND | ND |
| 9 | | 20:42:11 | ND | ND |
| 10 | | 20:54:08 | ND | ND |
| 11 | | 21:13:18 | ND | ND |
| 12 | | 21:24:24 | ND | ND |
| 13 | | 21:35:33 | ND | ND |
| 14 | | 21:56:30 | ND | ND |

Aerial Photography Results

A full set of high-resolution aerial digital photography were collected as part of each data collection pass. As with the missions on September 7, flight conditions were complicated by low ceiling and convective activity. An aerial image of the St. Rose refinery is given in Figure 5. No significant damage or activity is evident in the image. An oblique image of the Valero Meraux Refinery is shown in Figure 6. As indicated in IR images of the same facility, two flares can be observed indicating some activity within the facility.

Figure 5. MSIC image of the St Rose Refinery LLC - St Rose, Flight 12, September 8, 2021

Figure 6. Oblique photo of the Valero Meraux Refinery, Flight 12, September 8, 2021

## Conclusion

ASPECT conducted two missions on September 8, 2021 with the primary objective to complete the mission of collecting additional data at facilities assigned on 7 September. Weather conditions over the target areas within St. Bernard, Terrebonne, St. Charles, and St. James parishes was marginal due to clouds and convective activity. A total of 21 data collection passes (2 test and 19 active) were required to complete the mission with no detections observed.

## Appendix A: File Names of Data Collected During Flight

## St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 11, September 8, 2021

| Run# | Time (UTC) | Altitude (MSL) | Velocity (knots) | MSIC Data Files | FTIR Data Files | IRLS Data Files | Gamma Files |
|---|---|---|---|---|---|---|---|
| 1 | 13:33:30 | 3592 | 152 | 20210908133336255.jpg<br>20210908133342604.jpg<br>20210908133348968.jpg<br>20210908133350778.jpg | 20210908_133333_A.igm | 2021_09_08_13_33_34_R_01<br>TA=22.8;TB=43.6;Gain=3 | |
| 2 | 14:17:52 | 2868 | 106 | 20210908141759050.jpg<br>20210908141805409.jpg<br>20210908141811758.jpg<br>20210908141818122.jpg<br>20210908141824471.jpg<br>20210908141830826.jpg<br>20210908141837175.jpg<br>20210908141843533.jpg | 20210908_141755_A.igm<br>20210908_141835_A.igm | 2021_09_08_14_17_57_R_02<br>TA=18.0;TB=38.0;Gain=3 | |
| 3 | 14:40:19 | 2885 | 107 | 20210908144025438.jpg<br>20210908144031788.jpg<br>20210908144038152.jpg<br>20210908144044501.jpg<br>20210908144050860.jpg<br>20210908144057209.jpg | 20210908_144022_A.igm | 2021_09_08_14_40_24_R_03<br>TA=20.9;TB=41.0;Gain=3 | |
| 4 | 14:52:31 | 2887 | 107 | 20210908145237194.jpg<br>20210908145244464.jpg<br>20210908145250811.jpg<br>20210908145257176.jpg<br>20210908145303525.jpg<br>20210908145309874.jpg<br>20210908145316233.jpg<br>20210908145322582.jpg<br>20210908145328947.jpg | 20210908_145235_A.igm<br>20210908_145314_A.igm | 2021_09_08_14_52_36_R_04<br>TA=22.7;TB=42.6;Gain=3 | |
| 5 | 15:09:37 | 2946 | 103 | 20210908150943111.jpg<br>20210908150949454.jpg<br>20210908150955818.jpg<br>20210908151002170.jpg<br>20210908151008519.jpg<br>20210908151014883.jpg | 20210908_150939_A.igm | 2021_09_08_15_09_41_R_05<br>TA=23.9;TB=43.9;Gain=3 | |
| 6 | 15:21:28 | 2875 | 106 | 20210908152133983.jpg<br>20210908152140335.jpg<br>20210908152146684.jpg<br>20210908152153041.jpg<br>20210908152159406.jpg<br>20210908152205749.jpg<br>20210908152212114.jpg<br>20210908152219367.jpg<br>20210908152225732.jpg | 20210908_152130_A.igm<br>20210908_152210_A.igm | 2021_09_08_15_21_32_R_06<br>TA=23.2;TB=43.3;Gain=3 | |
| 7 | 15:34:50 | 2914 | 106 | 20210908153456558.jpg<br>20210908153502907.jpg<br>20210908153509271.jpg<br>20210908153515620.jpg<br>20210908153521979.jpg | 20210908_153453_A.igm | 2021_09_08_15_34_55_R_07<br>TA=22.4;TB=42.5;Gain=3 | |

# St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 12, September 8, 2021

| Run# | Time (UTC) | Altitude (MSL) | Velocity (knots) | MSIC Data Files | FTIR Data Files | IRLS Data Files | Gamma Files |
|---|---|---|---|---|---|---|---|
| 1 | 18:34:18 | 2559 | 130 | 20210908183424447.jpg<br>20210908183429907.jpg<br>20210908183435351.jpg | 20210908_183421_A.igm | 2021_09_08_18_34_22_R_01<br>TA=26.6;TB=46.8;Gain=3 | |
| 2 | 19:01:56 | 2560 | 107 | 20210908190202275.jpg<br>20210908190208624.jpg<br>20210908190214974.jpg<br>20210908190221338.jpg<br>20210908190227688.jpg | 20210908_190200_A.igm | 2021_09_08_19_02_00_R_02<br>TA=22.9;TB=43.0;Gain=3 | |
| 3 | 19:15:34 | 2545 | 100 | 20210908191540278.jpg<br>20210908191546643.jpg<br>20210908191552992.jpg | 20210908_191537_A.igm | 2021_09_08_19_15_38_R_03<br>TA=24.6;TB=44.5;Gain=3 | |
| 4 | 19:44:16 | 2545 | 106 | 20210908194422556.jpg<br>20210908194428908.jpg<br>20210908194436178.jpg<br>20210908194442527.jpg<br>20210908194448892.jpg | 20210908_194420_A.igm | 2021_09_08_19_44_21_R_04<br>TA=22.9;TB=42.8;Gain=3 | |
| 5 | 19:55:29 | 2538 | 105 | 20210908195535298.jpg<br>20210908195541663.jpg<br>20210908195548012.jpg<br>20210908195554377.jpg<br>20210908195600726.jpg<br>20210908195607080.jpg<br>20210908195613430.jpg<br>20210908195619799.jpg | 20210908_195532_A.igm<br>20210908_195611_A.igm | 2021_09_08_19_55_33_R_05<br>TA=26.8;TB=46.6;Gain=3 | |
| 6 | 20:07:03 | 2531 | 107 | 20210908200708943.jpg<br>20210908200715292.jpg<br>20210908200721641.jpg<br>20210908200728911.jpg<br>20210908200735260.jpg<br>20210908200741625.jpg<br>20210908200747974.jpg<br>20210908200754339.jpg<br>20210908200800688.jpg<br>20210908200807942.jpg<br>20210908200814307.jpg<br>20210908200820656.jpg | 20210908_200707_A.igm<br>20210908_200745_A.igm<br>20210908_200759_A.igm | 2021_09_08_20_07_07_R_06<br>TA=24.4;TB=44.1;Gain=3<br>2021_09_08_20_08_00_R_07<br>TA=24.3;TB=44.3;Gain=3 | |
| 7 | 20:19:49 | 2523 | 104 | 20210908201956101.jpg<br>20210908202002466.jpg<br>20210908202008815.jpg<br>20210908202015180.jpg<br>20210908202021529.jpg<br>20210908202027878.jpg | 20210908_201953_A.igm | 2021_09_08_20_19_54_R_08<br>TA=27.6;TB=47.6;Gain=3 | |
| 8 | 20:32:08 | 2533 | 108 | 20210908203214224.jpg<br>20210908203220573.jpg<br>20210908203226938.jpg<br>20210908203233287.jpg | 20210908_203211_A.igm | 2021_09_08_20_32_13_R_09<br>TA=26.9;TB=46.9;Gain=3 | |
| 9 | 20:42:11 | 2545 | 104 | 20210908204217063.jpg<br>20210908204223428.jpg<br>20210908204229782.jpg<br>20210908204237036.jpg<br>20210908204243396.jpg<br>20210908204244301.jpg | 20210908_204215_A.igm | 2021_09_08_20_42_16_R_10<br>TA=27.2;TB=47.3;Gain=3 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 10 | 20:54:08 | 2547 | 106 | 20210908205414302.jpg<br>20210908205421558.jpg<br>20210908205427923.jpg<br>20210908205434282.jpg<br>20210908205440631.jpg<br>20210908205446980.jpg<br>20210908205453345.jpg<br>20210908205459694.jpg | 20210908_205412_A.igm<br>20210908_205452_A.igm | 2021_09_08_20_54_13_R_11<br>TA=27.8;TB=47.8;Gain=3 | |
| 11 | 21:13:18 | 2550 | 104 | 20210908211324610.jpg<br>20210908211330959.jpg<br>20210908211337309.jpg<br>20210908211343673.jpg<br>20210908211350023.jpg | 20210908_211322_A.igm | 2021_09_08_21_13_23_R_12<br>TA=24.1;TB=44.2;Gain=3 | |
| 12 | 21:24:24 | 2539 | 103 | 20210908212430088.jpg<br>20210908212436447.jpg<br>20210908212442796.jpg<br>20210908212449155.jpg | 20210908_212427_A.igm | 2021_09_08_21_24_29_R_13<br>TA=23.8;TB=43.9;Gain=3 | |
| 13 | 21:35:33 | 2566 | 104 | 20210908213540115.jpg<br>20210908213546464.jpg<br>20210908213552826.jpg<br>20210908213559175.jpg<br>20210908213605534.jpg<br>20210908213611899.jpg | 20210908_213536_A.igm | 2021_09_08_21_35_38_R_14<br>TA=23.0;TB=42.8;Gain=3 | |
| 14 | 21:56:30 | 2558 | 105 | 20210908215635735.jpg<br>20210908215642084.jpg<br>20210908215649354.jpg<br>20210908215655701.jpg<br>20210908215702065.jpg<br>20210908215708415.jpg<br>20210908215714779.jpg<br>20210908215721129.jpg<br>20210908215727478.jpg | 20210908_215633_A.igm<br>20210908_215712_A.igm | 2021_09_08_21_56_35_R_15<br>TA=24.2;TB=44.1;Gain=3 | |

**Appendix B: Priority Sites Provided by EPA Region 6 & Louisiana Department of Environmental Quality**

| Facility_Name | Latitude | Longitude | Parish |
|---|---|---|---|
| Deltech LLC - Baton Rouge Facility | 30.552892 | -91.200536 | East Baton Rouge |
| ExxonMobil Chemical Co - Baton Rouge Plastics Plant | 30.551419 | -91.175611 | East Baton Rouge |
| ExxonMobil Baton Rouge Chemical Plant | 30.484336 | -91.169644 | East Baton Rouge |
| Marathon Petroleum Co LP | 30.068394 | -90.596364 | St. John the Baptist |
| Westlake Vinyls Co LP | 30.209167 | -91.017222 | Ascension |
| Valero Refining - Meraux LLC - Meraux Refinery | 29.930222 | -89.944917 | St. Bernard |
| Cornerstone Chemical Company | 29.964722 | -90.264722 | Jefferson |
| Chalmette Refining LLC | 29.937903 | -89.969903 | St. Bernard |
| ExxonMobil Chemical Company - Baton Rouge Chemicals North Plant | 30.50465 | -91.173219 | East Baton Rouge |
| Equilon Enterprises LLC - Norco Refinery | 29.995372 | -90.410167 | St. Charles |
| The Dow Chemical Company - Louisiana Operations | 30.313927 | -91.240586 | Iberville |
| Rubicon LLC - Geismar Facility | 30.20139 | -91.01222 | Ascension |
| BASF Corp - Geismar Site | 30.18425 | -91.002778 | Ascension |
| Union Carbide Corp - St. Charles Plant | 29.982289 | -90.455622 | St. Charles |
| Phillips 66 Co - Alliance Refinery | 29.68406 | -89.98145 | Plaquemines |
| Axiall LLC - Plaquemine Facility | 30.267167 | -91.184258 | Iberville |
| ExxonMobil Fuels & Lubricants Co - Baton Rouge Refinery | 30.484392 | -91.169444 | East Baton Rouge |
| Equilon Enterprises LLC dba Shell Oil Products US - Convent Refinery | 30.107684 | -90.890796 | St. James |
| Marathon Petroleum Company LP - Louisiana Refining Division - Garyville Refinery | 30.061322 | -90.593528 | St. John the Baptist |
| BASF Corp - Zachary Site | 29.547603 | -90.523231 | East Baton Rouge |
| Occidental Chemical Corporation - Geismar Facility | 30.18819 | -90.98188 | Ascension |
| St Rose Refinery LLC - St Rose Refinery | 29.950875 | -90.328497 | St. Charles |
| ExxonMobil Chemical Co - Baton Rouge Polyolefins Plant | 30.56215 | -91.20387 | East Baton Rouge |
| Shell Chemical LP - Norco Chemical Plant West Site | 30.004925 | -90.422381 | St. Charles |
| NOVA Chemicals Olefins LLC - Geismar Ethylene Plant | 30.230619 | -91.052884 | Ascension |
| Roehm America LLC - MMA Plant | 29.9575 | -90.265833 | Jefferson |
| Valero Refining - New Orleans LLC - St Charles Refinery | 29.985781 | -90.3955 | St. Charles |
| Shell Chemical LP - Norco Chemical Plant - East Site | 29.995556 | -90.409722 | St. Charles |
| BASF Corp - North Geismar Site | 30.20594 | -90.99195 | Ascension |
| Stolthaven New Orleans, LLC - Braithwaite Facility | 29.870919 | -89.949339 | Plaquemines |
| Shintech Louisiana LLC - Shintech Plaquemine Plant | 30.273611 | -91.173333 | Iberville |
| Denka Performance Elastomer LLC | 30.053928 | -90.524792 | St. John the Baptist |

| | | | |
|---|---|---|---|
| Formosa Plastics Corp Louisiana | 30.501722 | -91.185944 | East Baton Rouge |
| DuPont Specialty Products USA LLC - Pontchartrain Site | 30.05388 | -90.52472 | St. John the Baptist |
| Occidental Chemical Corp - Taft Plant | 29.987222 | -90.454722 | St. Charles |
| Syngenta Crop Protection LLC - St Gabriel Plant | 30.246728 | -91.103508 | Iberville |
| Mosaic Fertilizer LLC - Faustina Plant | 30.083914 | -90.91345 | St. James |
| Mosaic Fertilizer LLC - Uncle Sam Plant | 30.037222 | -90.8275 | St. James |
| LBC Baton Rouge LLC - Sunshine Terminal | 30.294444 | -91.148333 | Iberville |
| Occidental Chemical Corporation - Convent Facility | 30.055885 | -90.830594 | St. James |
| TOTAL Petrochemicals & Refining USA Inc - Carville Polystyrene Plant | 30.229786 | -91.073631 | Iberville |
| Targa Midstream Services LLC | 29.237034 | -89.384977 | Plaquemines |
| EnLink LIG Liquids LLC - Plaquemine Gas Processing Plant | 30.236389 | -91.241389 | Iberville |
| EnLink LIG Liquids LLC - Gibson Gas Processing Plant | 29.643056 | -90.961944 | Terrebonne |
| NuStar Logistics LP - St James Terminal | 30.030065 | -90.843463 | St. James |
| Enterprise Gas Processing LLC - Norco Fractionation Plant | 30.015411 | -90.402958 | St. Charles |
| Lone Star NGL Refinery Services LLC - Geismar Fractionation Plant | 30.218889 | -91.035833 | Ascension |
| INEOS Oxide - A Division of INEOS Americas LLC | 30.313889 | -91.240278 | Iberville |
| Discovery Producer Services LLC - Discovery Paradis Fractionation Plant | 29.858889 | -90.453333 | St. Charles |
| Plains Marketing LP - St James Terminal | 30.004341 | -90.848449 | St. James |
| Methanex USA Services LLC - Geismar Methanol Plant | 30.206667 | -91.020833 | Ascension |
| Dyno Nobel LA  Ammonia LLC - Ammonia Production Facility | 29.964789 | -90.264625 | Jefferson |
| Kinder Morgan Liquids Terminals LLC - Geismar Methanol Terminal | 30.205389 | -91.023792 | Ascension |
| South LA Methanol LP - St James Methanol Plant | 30.039917 | -90.863819 | St. James |
| YCI Methanol Plant | 29.97481 | -90.86775 | St. James |
| IGP Methanol LLC - Gulf Coast Methanol Complex | 29.625453 | -89.926611 | Plaquemines |
| KMe St James Holdings LLC - Methanol Terminal | 29.990919 | -90.841239 | St. James |
| Kemira Chemicals Inc | 29.964722 | -90.264722 | Jefferson |
| PHILLIPS 66 PIPELINE LLC | 29.923889 | -90.482498 | St. Charles |
| CF INDUSTRIES | 30.08328 | -90.957665 | Ascension |

## Appendix C: ASPECT Systems

The US EPA ASPECT system collects airborne infrared (IR) images and chemical screening data from a safe distance over the site (about 3,000 ft AGL). The system consists of an airborne high-speed Fourier Transform Infra-Red (FTIR) spectrometer coupled with a wide-area IR Line Scanner (IRLS). The ASPECT IR systems can detect chemical compounds in both the 8-to-12-micron (800 to 1200 cm-1) and 3 to 5 micron (2000 to 3200 cm-1) regions. List of chemicals and detection limits are listed in Table 1. The 8 to 12 micron region is typically known as the atmospheric window region since the band is reasonably void of water and carbon dioxide influence. Spectrally, this region is used to detect carbon - non-carbon bonded compounds. The 3 to 5 micron region is also free of water and carbon dioxide but typically does not have sufficient energy for use. This band does show use in high-energy environments such as fires. The carbon - hydrogen stretch is very common in this region.

An Imperx mapping camera (29 mega pixels; mapping focal plane array) is concurrently operated as part of all chemical collections. These images are often digitally processed in lower resolution, so they can be transmitted via satellite communication. All imagery is geo-rectified using both aircraft attitude correction (pitch, yaw, and roll) and GPS positional information. Imagery can be processed while in flight or approximately 600 frames per hour can be processed once the data are downloaded from the aircraft. The high-resolution images (>20 MB each) are pulled from the ASPECT after the sortie and are available later.

All aerial photographic images collected by the ASPECT system are ortho-rectified and geospatially validated by the scientific reach back team. In general, this consists of conducting geo-registration using a USGS Digital Elevation Model (DEM) which promotes superior pixel computation and lessens topographic distortion. The image is check by the team (using a Google Earth base map) for proper location and rotation.

Airborne radiological measurements are conducted using three fully integrated multi-crystal sodium iodide (NaI) RSX4 gamma ray spectrometers. Each RSX4 spectrometer contains four 4”x2”x16” doped NaI crystals each having an independent photomultiplier/ spectrometer assembly. One RSX unit is configured with an additional upward NaI crystal utilized to provide real-time cosmic ray correction. Count and energy data from each crystal and pack is combined using a self-calibrating signal processor to generate a virtual detector output. All radiological spectrometer “packs” are further combined using a signal console controlled by the on-board central computer in the aircraft. Altitude correction data is provided by a radar altimeter with internal GPS systems within the packs serving as a backup. It should be noted that no radiological measurements were conducted on this mission.

Data is processed using automated algorithms onboard the aircraft with preliminary results being sent using a satellite system to the ASPECT scientific reach back team for QA/QC analysis. Upon landing, preliminary data results are examined and validated by the

scientific reach back team.

Table 1. ASPECT Automated Compounds

This table contains ASPECT's library of automated compounds.
Detection limits are for each chemical is found in parenthesis in units of parts per million (ppm)

| | | | |
|---|---|---|---|
| **Acetic Acid (2.0)** | **Cumene (23.1)** | **Isoprene (6.5)** | **Phosphine (8.3)** |
| **Acetone (5.6)** | **Diborane (5.0)** | **Isopropanol (8.5)** | **Phosphorus Oxychloride (2.0)** |
| **Acrolein (8.8)** | **1,1-Dichloroethene (3.7)** | **Isopropyl Acetate (0.7)** | **Propyl Acetate (0.7)** |
| **Acrylonitrile (12.5)** | **Dichloromethane (6.0)** | **MAPP (3.7)** | **Propylene (3.7)** |
| **Acrylic Acid (3.3)** | **Dichlorodifluoromethane (0.7)** | **Methyl Acetate (1.0)** | **Propylene Oxide (6.8)** |
| **Allyl Alcohol (5.3)** | **1,1-Difluoroethane (0.8)** | **Methyl Acrylate (1.0)** | **Silicon Tetrafluoride (0.2)** |
| **Ammonia (2.0)** | **Difluoromethane (0.8)** | **Methyl Ethyl Ketone (7.5)** | **Sulfur Dioxide (15)** |
| **Arsine (18.7)** | **Ethanol (6.3)** | **Methanol (5.4)** | **Sulfur Hexafluoride (0.07)** |
| **Bis-Chloroethyl Ether (1.7)** | **Ethyl Acetate (0.8)** | **Methylbromide (60)** | **Sulfur Mustard (6.0)** |
| **Boron Tribromide (0.2)** | **Ethyl Acrylate (0.8)** | **Methylene Chloride (1.1)** | **Sulfuryl Fluoride (1.5)** |
| **Boron Triflouride (5.6)** | **Ethyl Formate (1.0)** | **Methyl Methacrylate (3.0)** | **Tetrachloroethylene (10)** |
| **1,3-Butadiene (5.0)** | **Ethylene (5.0)** | **MTEB (3.8)** | **1,1,1-Trichloroethane (1.9)** |
| **1-Butene (12.0)** | **Formic Acid (5.0)** | **Naphthalene (3.8)** | **Trichloroethylene (2.7)** |
| **2-Butene (18.8)** | **Freon 134a (0.8)** | **n-Butyl Acetate (3.8)** | **Trichloromethane (0.7)** |
| **Carbon Tetrachloride (0.2)** | **GA (Tabun) (0.7)** | **n-Butyl Alcohol (7.9)** | **Triethylamine (6.2)** |
| **Carbonyl Fluoride (0.8)** | **GB (Sarin) (0.5)** | **Nitric Acid (5.0)** | **Triethylphosphate (0.3)** |
| **Carbon Tetraflouride (0.1)** | **Germane (1.5)** | **Nitrogen Mustard (2.5)** | **Trimethylamine (9.3)** |
| **Chlorodifluoromethane (0.6)** | **Hexafluoroacetone (0.4)** | **Nitrogen Trifluoride (0.7)** | **Trimethyl Phosphite (0.4)** |
| **Chloromethane (12)** | **Isobutylene (15)** | **Phosgene (0.5)** | **Vinyl Acetate (0.6)** |